THE UNIVERSITY OF ALBERTA

RELAXATION TRAINING : EMG FEEDBACK WITH CHILDREN

BY

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1976

ABSTRACT

The purpose of this study was to investigate the relative effectiveness of EMG feedback training as a relaxation training technique for children. This inquiry was made by comparing the effects of EMG feedback training and Jacobson's progressive relaxation practices on tension levels in the frontalis (forehead) muscles of young subjects.

Subjects for this study were drawn from the grade six students attending an elementary school in a city of approximately 450,000 residents in northern Alberta. The grade six student body comprised 60 boys and 60 girls, from which 15 male and 15 female subjects were randomly selected and assigned to one of the following groups : experimental group I, which received training in progressive relaxation for the forehead, experimental group II, which received EMG audio feedback training on the frontalis and group III (control), which received no relaxation training.

Each of the 30 subjects individually participated in one orientation session, one pretreatment session, four treatment sessions and two post-treatment sessions, all of approximately 30 minutes duration. With the exception of the last post-treatment session, which was conducted 28 days after the first post-treatment

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Subjects for this study were drawn from the grade six students attending an elementary school in a city of approximately 400,000 residents in northern Alberta. The grade six student body comprised 49 boys and 60 girls, from which 15 male and 15 female subjects were randomly selected and assigned to one of the following groups : experimental group I, which received training in progressive relaxation for the forehead, experimental group II, which received EMG audio feedback training on the frontalis and group III (control), which received no relaxation training.

Each of the 30 subjects individually participated in one orientation session, one pre-treatment session, four treatment sessions and two post-treatment sessions, all of approximately 30 minutes duration. With the exception of the last post-treatment session, which was conducted 25 days after the first post-treatment

session, the sessions were scheduled on consecutive weekdays.

During the treatment sessions, EMG audio feedback was provided for the subjects in group II by means of a feedback myograph. The feedback myograph was also used in conjunction with a digital integrator to record average EMG activity in the frontalis. Muscle tension scores for each subject consisted of average EMG activity, in microvolts, recorded during the pretreatment and post-treatment sessions.

The findings of this study supported the basic hypothesis that EMG feedback training is a more effective type of relaxation training for children than relaxation training based on Jacobson's progressive relaxation techniques. During the first post-treatment session, both experimental groups exhibited significantly lower mean levels of muscular tension than the control group, with the feedback group demonstrating a significantly lower mean level of muscular tension than the progressive relaxation group. However, during the last post-treatment session, only the feedback group showed a significantly lower mean level of muscular tension than the control group. These findings were interpreted and implications for further research were discussed.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. E. E. Fox for his help, guidance and encouragement.

Gratitude, for their assistance, is also extended to Dr. D. G. Danskin, Dr. P. W. Koziey, Dr. K. A. Neufeld, Dr. R. Pettifor, Dr. D. D. Sawatzky, fellow graduate students and all those who participated in the research.

TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Relaxation Training in Therapy

Training in the relaxation of striate muscle is frequently a component in psychotherapy and in the treatment of psychosomatic disorders. In psychotherapy, where relaxation training is most commonly applied to anxiety reduction, Haugen, Dixon and Dickel (1958), Jacobson (1967a, 1970), Mischel (1968), Payne (1970), Schultz and Luthe (1959) and Wolpe (1958, 1969) are among the many investigators who have provided evidence of the therapeutic effects of relaxation training.

With respect to the treatment of psychosomatic disorders, investigators report that training in relaxation has been associated with the reduction or cessation of such diverse conditions as bronchial asthma (Davis, 1972; Dickel, Dixon, Shanklin, & Phillips, 1967; Jacobson, 1938), disorders of the gastrointestinal tract (Jacobson, 1938; Schultz & Luthe, 1959), spasmodic torticollis (Cleeland, 1973) and tension headaches (Budzynski, Stoyva, Adler, & Mullaney, 1973; Wickramasekera, 1972). However, as Luce and Peper (1971) caution, "in the course of psychosomatic illnesses there seems to be a point at which organic damage may not be reversible (p. 34)." In the view of these authors, the greatest potential for relaxation training

may lie in its preventive, rather than curative, role.

Relaxation Training as a Preventive Measure

Although relaxation training has been promoted in the treatment of various tension disorders, the concept of relaxation training as a preventive measure is neither new nor obsolete. Haugen et al. (1958) suggest that the incidence of anxiety reactions would be reduced if healthy, normal children were taught the principles of relaxation. Jacobson (1967a) also favors the inclusion of relaxation training, as preventive medicine, in general education curricula. In agreement with Luce and Peper (1971), Haugen et al. (1958) and Jacobson (1967a), Brown (1974) argues that "to live without tension (and tension is expressed in muscle tension) is the strongest protection known against the large family of psychosomatic illness, as well as being the greatest insurance against emotional illness (p. 120)."

Unfortunately, although Haugen et al. (1958) have suggested that research be conducted to investigate the long term effects of early training in relaxation, no such study appears to have been undertaken. Therefore, the preventive value of relaxation training is open to question. In addition, there is virtually no empirical evidence regarding the relative effectiveness of different types of relaxation training with children.

Nature of Relaxation Training

As conceived for the purpose of this study, relaxation training refers to procedures which seek to enable individuals to voluntarily achieve low levels of muscular tension in striate muscle. Accordingly, Jacobson's (1938, 1963, 1970) relaxation techniques, Schultz and Luthe's (1959) autogenic training and electromyographic (EMG) feedback, for example, qualify as forms of relaxation training, whereas drug therapy and hypnosis do not meet the criterion of voluntary control.

Measurement of Muscular Tension

Until recently, the subjective estimation of muscular tension, and the evaluation of muscular tension by visual inspection, predominated in both the experimental and clinical settings. However, Budzynski and Stoyva (1969) and Jacobson (1938, 1967b, 1970) are certainly not alone in their observation that individuals are often unaware of relatively high levels of muscular tension. At the same time, it is not easy for the therapist or experimenter to accurately judge the state of an individual's muscles. Even in small joints, such as those of the thumb, at least two or three motor units are needed to give a visible movement (Basmajian, 1967). Thus, while the signs of gross muscular tension, such as the presence of fidgets and

because he is unable to locate his tensions, the development of "muscle sense" is considered to be an aid toward the control of muscular tension. To this end, the subject is instructed to perform an activity which involves contracting the muscle group in question and to note the accompanying sensation of "tenseness." Instructions in relaxation entail the use of such phrases as "do the reverse of this" and "go in the negative direction." The extent of contraction is gradually lessened until slight contractions are perceptible to the subject. Jacobson (1938, 1967a) claims that progressive relaxation is generally effective, as a relaxation training technique, for both adults and children.

Autogenic training. A common type of relaxation training used in Germany, which was virtually unknown in North America until Green et al. (1970) devised autogenic feedback training, is Schultz and Luthe's (1959) autogenic training. Based on the observation that a feeling of heaviness in the body accompanies muscular relaxation, the central theme of the standard autogenic exercises, aimed at muscular relaxation, is the cultivation of a feeling of heaviness in various parts of the body. Autogenic training is usually begun on the right arm (for right-handed subjects). During the first standard exercise, the instructor voices a formula containing the repeated phrase "my

right arm is heavy," in combination with a background formula, such as "I am at peace." The subject then engages in a very brief period of passive concentration on the formulae. When each step in a series of exercises has been introduced by the instructor, the subject carries out his own program by performing a number of daily exercises. However, while Luthe (1971) and Schultz and Luthe (1959) claim that autogenic training is usually successful as a relaxation training technique for adults, the originators of autogenic training report that the application of autogenic training to children appears limited.

EMG feedback. Although the general concept of feedback has long been of importance in the area of learning, and the significance of information feedback in the mastery of psychomotor tasks has been convincingly demonstrated numerous times, EMG feedback is a comparatively recent innovation in self-induced muscle relaxation procedures (Cleaves, 1970). This biofeedback technique uses electronic detection to provide the subject with immediate and continuing signals on changes in EMG activity. According to Gaarder (1971), the basic idea behind EMG feedback is that amplifying muscle potentials and feeding this information back to the subject assists him in "shaping" his responses in the direction of muscular relaxation. More specifically, Budzynski (1973) claims

that biofeedback, including EMG feedback, develops increased awareness of the relevant internal physiologic functions, or events, and enables the subject, through a process of trial and error, to evolve strategies for controlling the feedback and thus the response.

In EMG feedback, the frontalis and forearm extensors are the most commonly used muscle groups (Lader & Mathews, 1971). For a number of reasons, the frontalis is generally considered to be an appropriate site for EMG feedback. Firstly, the frontalis is a relatively difficult muscle to relax (Balshan, 1962; Budzynski & Stoyva, 1972; Gaarder, 1971). Therefore, any relaxation procedure that is successful with the frontalis should be readily applicable to other muscle groups (Budzynski & Stoyva, 1969). Secondly, Budzynski and Stoyva (1969; 1972) report that deep relaxation of the frontalis appears to be followed by a generalization of relaxation to other muscle groups. On the other hand, the forearm extensors are also popular in EMG feedback, because they are relatively easy to relax (Budzynski & Stoyva, 1972). Nevertheless, investigators have used other sites for EMG feedback. For example, Budzynski and Stoyva (1972, 1973) have worked with the masseter, while Jacobs and Felton (1969) have used the upper trapezius. In addition, Whatmore and Kohli (1968)

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regularly use a variety of muscular sites, including those of the legs, jaw, throat and breathing regions. However, regardless of the sites used, investigators have reported that EMG feedback is a fast and effective relaxation training technique for adults (Budzynski & Stoyva, 1969, 1973; Budzynski, Stoyva, & Adler, 1970; Budzynski et al., 1973; Cleaves, 1970; Green, Walters, Green, & Murphy, 1969; Jacobs & Felton, 1969; Reinking & Kohl, 1974; Whatmore & Kohli, 1968). In addition, Budzynski and Stoyva (1969, 1972) indicate that EMG feedback has been successful where other methods of relaxation training have failed. Unfortunately, despite the fact that Fruhling, Basmajian and Simmard (1969) have shown that young children can gain remarkable control of striate muscle through EMG feedback, there appears to be virtually no data available regarding the effectiveness of EMG feedback as a relaxation training technique for children.

The Problem

In view of the increasing use of EMG feedback, there appears to be a need to investigate the relative effectiveness of EMG feedback as a relaxation training technique for children. Since autogenic training is problematic in the case of children, the current study seeks to compare the effectiveness of EMG feedback with that of progressive relaxation. More generally,

this study is seen as a prerequisite to an investigation that would determine the long term effects of early training in relaxation.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Origins of Excess Muscular Tension

Most therapists are willing to concede that inherited factors may contribute to an individual's susceptibility to the development of excess muscular tension. As Davidson (1967) observes, excess muscular tension does run in families, although this does not constitute proof of genetic transmission. Perhaps the most impressive evidence in support of the involvement of inherited factors in the development of excess muscular tension is to be found in the work of Jost and Sontag (1944). Concerning the relationship between physiological measures of anxiety and heredity, these investigators obtained correlations of .49 for monozygotic twins, .26 for dizygotic twins and .16 for unrelated children. Nevertheless, the majority of investigators in the area concentrate on the environmental factors involved in the development of excess muscular tension. In support of the hypothesis that environmental factors are significant, Haugen et al. (1958) note that the incidence of excess muscular tension varies according to cultural background. However, despite differences in theoretical perspective, most theorists agree that excess muscular tension begins to develop early in life (Budzynski, 1973;

Haugen et al., 1958; Hefferline & Bruno, 1971; Lang, 1970; Wolpe, 1958).

Some theorists subscribe to the idea that excess muscular tension is at least partly learned through observation or as a result of accidental reinforcement. Haugen et al. (1958), for example, maintain that patterns of excess muscular tension, and attitudes conducive to their development, are acquired mainly through the example and instruction of tense parents. On the other hand, Budzynski (1973) and Whatmore and Kohli (1968) suggest that accidental reinforcement is partly responsible for the establishment of excess muscular tension in some instances. It appears to be consistent with the view of these authors, that the mother who allows her child to stay home from school when he has a tension headache, may be inadvertantly reinforcing the production of the sustained contractions of the neck and scalp muscles associated with tension headaches. In this context, it is interesting to note an experiment conducted by Lang (1970) on the basis of the assumption that maladaptive behaviors can arise through accidental reinforcement. Lang (1970) successfully treated a boy of 9 months, who regularly vomited his entire meal and was not expected to live, by applying aversive electric shocks to his leg whenever the first wave of reverse peristalsis was detected by means of

electromyography.

However, a significant number of theorists assume that excess muscular tension arises when functional muscular tension becomes a habitual response (Hefferline & Bruno, 1971; Jacobson, 1967b; Perls, Hefferline, & Goodman, 1951; Rinehart, 1967; Whatmore & Kohli, 1968). In agreement with Perls et al. (1951), Hefferline and Bruno (1971), for example, maintain that chronic or recurrent muscular tensions are somatic residuals "persisting from earlier life periods when they had done service with some effectiveness in holding back strong, but punishable behavior from overt expression (p. 166)." According to these authors, excess muscular tension occurs when the individual comes to tense automatically without remembering why. Hefferline and Bruno (1971) stress, however, that simple forgetting, rather than repression, accounts for the failure to remember. In support of this hypothesis, Hefferline (1958) reports that when a "muscular block" is definitely resolved, subjects frequently claim that they experience vivid, spontaneous recall of typical situations, sometimes dating back to childhood, when they learned to tense in a particular manner. Rinehart (1967) also conceives chronic muscular tension as muscular tension that has become habitual. However, like Jacobson (1967b), Rinehart (1967) suggests that muscular tension is

practiced because of "our instinctive reaction of bracing (going on guard) whenever we encounter any uncertainties in life (p. 61)." Similarly, Whatmore and Kohli (1968) support the notion that excess muscular tension arises when muscular tension that is appropriate in certain situations is automatically applied under conditions where it is not appropriate. By means of illustration, Whatmore and Kohli (1968) indicate that although bracing efforts may be fitting in some threatening situations, they are inappropriate in meeting most intellectual challenges.

In addition, a number of theorists hypothesize that excess muscular tension has its source in mental disorder. It is consistent with traditional psychoanalytic theory, for instance, that dysfunctional tension, of which excess muscular tension is a manifestation, is a symptom of faulty mental development. According to Freud (1936), "so many people remain infantile, continuing to react with anxiety to situations which should long have ceased to evoke it; for it is exactly such persons whom we call neurotics (p. 91)." Within this context, excess muscular tension is an indication of a more pervasive problem.

Maintenance of Excess Muscular Tension

As opinions vary regarding the origin of excess

muscular tension, so they differ with respect to the factors accounting for its maintenance. Some investigators, including Budzynski (1973) and Whatmore and Kohli (1968), assume that reinforcement is responsible for the persistence of excess muscular tension in some instances. On the basis of his clinical experience with EMG feedback, Budzynski (1973) notes that a "troublesome situation for the therapist occurs when the patient is getting positive reinforcement for maintaining his maladaptive behavior, or when he uses his symptoms to avoid certain feared situations (p. 444)." This observation has an obvious implication for relaxation training; where excess muscular tension is being sustained by reinforcement, relaxation training is likely to be ineffective. However, the fact that relaxation training is generally effective, suggests that reinforcement is not a significant factor in the maintenance of excess muscular tension in many cases.

A significant number of theorists, however, subscribe to the idea that excess muscular tension is largely sustained by a lack of awareness of its presence (Budzynski & Stoyva, 1972; Green et al., 1970; Haugen et al., 1958; Hefferline & Bruno, 1971; Jacobson, 1967b; Luce & Peper, 1971; Perls, Hefferline, & Goodman, 1951; Rinehart, 1967; Whatmore & Kohli, 1968). According to Haugen et al. (1958), for example,

individuals become so accustomed to their average level of muscular tension that they are unaware of its existence. In the experience of these authors, people are usually only cognizant of higher and more prolonged peaks of muscular tension than they customarily produce. Haugen et al. (1958) claim that individuals suffering from acute muscular tension frequently, mistakenly, believe that they were free from excess muscular tension prior to the onset of their present difficulty. Similarly, Whatmore and Kohli (1968) assume that the errors of effort involved in excess muscular tension are mainly made "unknowingly and go unnoticed by both the person making them and others observing him (p. 105)." As previously mentioned, there is evidence that individuals are commonly unaware of the presence of muscular tension. Green et al. (1970), for instance, report that a continuous firing of motor units can be registered through electronic detection, even though the subject experiences no feelings of muscular tension. It is apparent that progressive relaxation aims at developing such awareness. However, as Brener and Hothersall (1966) observe, an important determinant of where a particular response falls on the voluntary-involuntary continuum is the availability of sensory feedback from the response in question. Following this line of reasoning, Green et al. (1970)

argue that, due to the lack of exteroceptive feedback, and the low levels of proprioceptive feedback, deep muscular relaxation may not be voluntary in the usual sense. Certainly, in the control of subtle muscular tensions, EMG feedback could be expected to be more effective than progressive relaxation, since EMG feedback provides continuous, augmented feedback.

Alternatively, it is consistent with psychoanalytic theory that excess muscular tension is merely a symptom of unconscious mental conflict, and, as such, is not an appropriate target of therapy. Expressed differently, from the psychoanalytic perspective, allieviating excess muscular tension does not eliminate its cause and is likely to lead to symptom substitution. In this view, psychoanalysis, rather than relaxation training, is the correct approach to the problem of excess muscular tension. However, as Mischel (1968) observes, a review of the relevant literature indicates that psychoanalysis has been relatively ineffective in reducing excess muscular tension, and that there is no basis for the assumption that training directed at eliminating maladaptive behavior results in symptom substitution. However, this does not mean that relaxation training has no role to play in psychoanalysis. As Gaarder (1971) points out, relaxation training may be useful in helping patients to achieve the

psychophysiological state accompanying free association.

Progressive Relaxation and Muscular Tension

Although it has been used widely in the treatment of psychological and psychosomatic ailments, progressive relaxation has not been subjected to extensive evaluation as a relaxation training technique. Wolpe (1969) seems to reflect the general feeling of therapists when he maintains that the equipment required to measure muscular tension is "too laborious for routine use (p. 122)." On the other hand, despite the fact that he has been using electromyography since the early 1930's, Jacobson (1938, 1963, 1967a, 1967b, 1970) has provided virtually no objective, scientific data. As Lader and Mathews (1971) aptly observe, "the lack of control groups and of statistical analysis prevents scientific evaluation of Jacobson's work (p. 483)." However, Reinking and Kohl (1974) found that subjects treated with Jacobson-Wolpe instructions showed a significant reduction in muscular tension, while control subjects did not master relaxation at all.

Nevertheless, the general applicability of progressive relaxation is somewhat in question. While Jacobson (1938, 1967a) maintains that progressive relaxation is generally successful with both children

and adults, Budzynski and Stoyva (1969, 1972) have encountered subjects demonstrating a marked inability to relax despite training in progressive relaxation. In this regard, Jacobson (1938) admits that some individuals may take months, or even years, to profit from training in progressive relaxation.

EMG Feedback and Muscular Tension

As previously mentioned, a number of investigators have indicated that EMG feedback is a fast and effective way of reducing muscular tension. One of the earliest uses of EMG feedback is to be found in the work of Whatmore and Kohli (1968), who used it during the early 1950's in teaching muscular relaxation (Gaarder, 1971). Unfortunately, Whatmore and Kohli (1968) failed to quantify their results. However, as a result of an attempt to induce deep relaxation in large forearm muscle bundles, Green et al. (1969) found that with the aid of EMG feedback, "seven out of twenty-one subjects were able to achieve neuromuscular silence within twenty minutes and maintain it for the duration of an experiment, thirty minutes or more (p. 37)." At about the same time, Jacobs and Felton (1969) reported that, with 30 minutes of EMG feedback from the upper trapezius, both normal subjects, and patients with neck injuries, demonstrated a significantly greater reduction in muscular tension than comparable groups

of untreated subjects. In addition, Budzynski and Stoyva (1973) discovered that subjects who participated in a 20 minute EMG feedback session, reduced their masseter EMG activity significantly more than those who did not receive EMG feedback.

Of course, the ultimate purpose of EMG feedback, as a relaxation training technique, is to enable individuals to relax without the continued necessity for EMG feedback. On the basis of pretreatment and post-treatment EMG recordings, Budzynski and Stoyva (1969) discovered that, with EMG feedback from the frontalis, subjects were able to reduce their muscle potential levels by 50% after only three 30 minute feedback sessions. In contrast, no-feedback subjects showed a mean decrease of only 24%, and irrelevant feedback subjects a mean increase of 28% in muscle potential levels. In an extension of these findings to five patients with tension headaches, which are associated with sustained contractions of the neck and scalp muscles (Martin, 1966; Ostfeld, 1962; Sainsbury & Gibson, 1954; Wolff, 1963), Budzynski, Stoyva and Adler (1970) demonstrated that, after receiving EMG feedback from the frontalis, the patients experienced a significant reduction in both muscular tension and the intensity and frequency of tension headaches. As the patients progressed through the 4 to 8 week program, which included two or three 30 minute feedback sessions

per week, they reported a heightened awareness of maladaptive tension arising and an increasing ability to reduce such tension in their daily lives. To rule out the possibility that these results were mainly attributable to placebo or suggestion effects, Budzynski et al. (1973) initiated another study, which employed a pseudofeedback control group and a no-treatment control group in addition to the experimental group. Again, the EMG feedback group showed a significant reduction in muscular tension and headache activity, while the control groups failed to show significant reductions. Furthermore, 3 months after training had ceased, the EMG feedback group retained low levels of muscular tension and headache activity. Also working with the frontalis, Cleaves (1970) found that female volunteers exposed to a 30 minute EMG feedback session, demonstrated a significantly greater reduction in muscular tension than no-treatment subjects during training, immediately following training and 1 week after training.

EMG Feedback and Progressive Relaxation : Comparative Studies

As previously mentioned, Budzynski and Stoyva (1969, 1972) indicate that EMG feedback has been successful in a number of cases where other methods of relaxation training have failed. Unfortunately, few investigators have responded to the challenge of Budzynski and

Stoyva's (1969) suggestion that a precise comparison be made of the effectiveness of EMG feedback and progressive relaxation. However, Reinking and Kohl (1974) found that EMG feedback was significantly more effective in reducing muscular tension in the frontalis than Jacobson-Wolpe instructions. Reinking and Kohl (1974) report that the EMG groups were superior to the classical relaxation training group, both in speed of learning and depth of relaxation. In addition, Cleaves (1970) discovered that EMG feedback was significantly more effective in reducing muscular tension in the frontalis than a combination of the relaxation training approaches of Jacobson (1938), Wolpe and Lazarus (1966), Schultz and Luthe (1959) and Cox (1968). However, in this study, while EMG feedback was limited to the frontalis, the verbal training was not limited to the forehead region. This appears to be a doubtful procedure when making such a comparison.

Hypotheses

A number of hypotheses, including those to be empirically examined in this study, are suggested by the preceding discussion. The basic hypothesis to be tested, which subsumes the following specific hypotheses, is that EMG feedback (group II) is a more effective type of relaxation training for children than relaxation

training based on Jacobson's progressive relaxation techniques (group I).

1. Groups I and II, in contrast with the control group (group III), will exhibit lower levels of muscular tension in the frontalis 1 day after treatment.
2. Group II, in comparison with group I, will show a lower level of muscular tension in the frontalis 1 day after treatment.
3. Groups I and II, in contrast with group III, will demonstrate lower levels of muscular tension in the frontalis 29 days after treatment.
4. Group II, in comparison with group I, will evidence a lower level of muscular tension in the frontalis 29 days after treatment.

CHAPTER III

DESIGN AND PROCEDURE

Sample

Subjects for this study were drawn from the grade six students attending an elementary school in a city of approximately 450,000 residents in northern Alberta. Prior to the initiation of this study, which was presented to the students and their parents as an extracurricular course in relaxation training, a relaxation training "workshop" was offered to the parents of all grade six students. During this workshop, a number of different relaxation techniques, including those used in the study, were demonstrated. The grade six student body comprised 60 boys and 60 girls, from which 15 male and 15 female subjects were randomly selected and assigned to one of the following groups: experimental group I, which received training in progressive relaxation for the forehead, experimental group II, which received EMG feedback training on the frontalis and group III (control), which received no relaxation training. Parental permission for participation in the program was obtained for all subjects.

Procedure

The 30 subjects individually participated in one orientation session, one pretreatment session, four

treatment sessions and two post-treatment sessions, each of approximately 30 minutes duration. With the exception of the last post-treatment session, which was conducted 28 days after the first post-treatment session, the sessions were scheduled on consecutive weekdays for each subject, beginning with the orientation session on a Friday. By following this schedule, the pretreatment and both post-treatment sessions occurred on the same day of the week (Monday). In addition, the time of day during which subjects participated in the study was balanced for the three groups, in order to control for the possible effects of daily biological rhythms. All sessions comprised a period of subject preparation and a 15 minute recording phase, during which average EMG activity from the frontalis was recorded for five 2 minute periods, each 1 minute apart, commencing after the first minute. This particular recording schedule was adopted, so that recordings would not be made while the group I subjects were being instructed to tense the forehead in the recording phases of the treatment sessions. Recording was performed during the treatment sessions in an attempt to standardize procedures across all sessions. During the recording phase of each session, the subjects were seated comfortably in a chair with their hands resting on their laps. In the cause of standardizing the sitting

position, the subjects were instructed to place their feet on two large footprints, which were fixed on the floor in front of the chair. In addition, the subjects wore adjustable earphones and surface electrodes. The two active electrodes were attached 1 inch above the eyebrows, with a reference electrode between them in the center of the forehead (Davis, 1959).

Standardized, verbal instructions were used by the experimenter for each session. However, during the recording phase of the treatment sessions the verbal instructions were presented in the form of tape recordings, in order to control the amount of direct experimenter-subject interaction for the experimental and control groups.

Orientation session. At the beginning of the orientation session, which was designed to adjust the subjects to the experimental environment, the experimenter instructed each subject as follows: "Hello, X. We shall work for about 30 minutes today. All I want you to do is to sit in this chair and relax as completely as you can. I shall be measuring how well you are relaxing with this machine. When the discs of this machine are attached to the body, this machine measures muscle relaxation like a thermometer measures temperature. To see how well you are relaxing, I shall attach these discs to your forehead. Now, please sit with your feet on the footprints and your

hands resting on your lap." (Electrodes attached.) "After I have put on your earphones, please try to sit still. Your task for the rest of the session is to relax as completely as you can, especially your forehead muscle, but do not go to sleep or close your eyes. Remember, I shall be measuring how well you are relaxing. Any questions? Are you comfortable?" (Earphones put on.) For the next 15 minutes, the subject remained attached to the EMG recording equipment. In order to simulate the environment of the experimental sessions as closely as possible, the EMG recording equipment was activated and programmed to calculate average EMG activity, according to the recording schedule previously mentioned.

Pretreatment session. The experimenter prepared each subject for the recording phase of the pretreatment session as follows: "Hello, X. We shall work for about 30 minutes today. All I want you to do is to sit in this chair, relax as completely as you can and follow the directions that you are given. To measure how well you are relaxing, I shall attach the discs of this machine to your forehead. Now, please sit with your feet on the footprints and your hands resting on your lap." (Electrodes attached.) "After I have put on your earphones, please try to sit still. Your task for the rest of the session

is to relax as completely as you can, especially your forehead muscle, but do not go to sleep or close your eyes. Remember, I shall be measuring how well you are relaxing. Any questions? Are you comfortable?" (Earphones put on.) Following the subject preparation period of the pretreatment session, each subject sat quietly during the 15 minute recording phase.

Treatment sessions. Each subject was prepared for the recording phases of the treatment sessions as follows: "Hello, X. We shall work for about 30 minutes today. All I want you to do is to sit in this chair, relax as completely as you can and follow the directions that you are given. To measure how well you are relaxing, I shall attach the discs of this machine to your forehead. Now, please sit with your feet on the footprints and your hands resting on your lap." (Electrodes attached.) "Today, you will be receiving instructions through your earphones. Please listen to these instructions carefully and do exactly what they say. I shall continue to measure how well you are relaxing. Any questions? Are you comfortable?" (Earphones put on.) During the recording phases of the treatment sessions, the treatment given to the subject varied according to group membership. Subjects in group I were instructed in Jacobson's (1938, 1970) relaxation practices for the forehead. (For transcript of progressive relaxation

training tape recording, see Appendix A.) Subjects in group II received audio EMG feedback from the frontalis. (For transcript of EMG feedback training tape recording, see Appendix B.) Group III subjects received no relaxation training, beyond the instruction to relax. (For transcript of no relaxation training tape recording, see Appendix C.)

Post-treatment sessions. At the beginning of each of the two post-treatment sessions, the subjects received the following instructions: "Hello, X. We shall work for about 30 minutes today. All I want you to do is to sit in this chair, relax as completely as you can and follow the directions that you are given. To measure how well you are relaxing, I shall attach the discs of this machine to your forehead. Now, please sit with your feet on the footprints and your hands resting on your lap." (Electrodes attached.)" After I have put on your earphones, please try to sit still. Your task for the rest of the session is to relax as completely as you can, especially your forehead muscle. Start from where you are now, using any skills that you may have learned during the previous sessions, but do not go to sleep or close your eyes. I shall continue to measure how well you are relaxing. Any questions? Are you comfortable?" (Earphones put on.) After each of the subject preparation periods, the subjects sat quietly through

the recording phases of the post-treatment sessions.

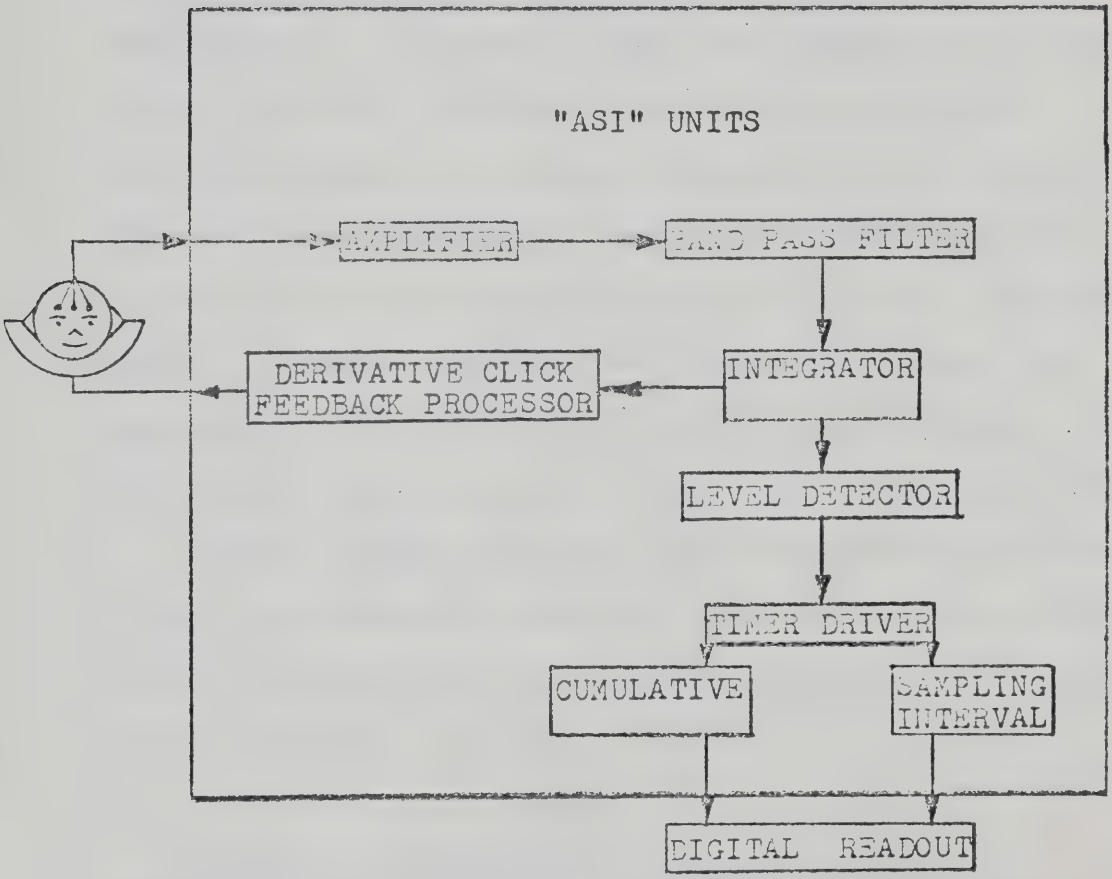
Instrumentation

EMG recording and scoring equipment. The ASI (Autogenic Systems, Inc.) Autogen 1500 feedback myograph was used, in conjunction with the Autogen 5100 digital integrator, to measure EMG activity in the frontalis. One of the main components of the feedback myograph was a differential amplifier, which exhibited low internal noise levels (0.1 µV noise). Also incorporated in the feedback myograph was a bandpass filter, for the rejection of electroencephalographic (EEG) and electrocardiographic (EKG) artifacts. To reduce external electrical interference, the feedback myograph was equipped with shielded electrode cables, and had high common mode and 60 Hz rejection characteristics. The feedback myograph was capable of registering EMG activity changes within the amplitude range of 0.1 to 2000 µV. Silver/silver chloride electrodes, each embedded in a plastic insulator disc, were used to pick up the muscle potentials in the frontalis region. Biogel biopotential contact medium was used in the cups of the electrode insulation discs, which were attached to the skin by means of doughnut-shaped adhesive discs. Used in conjunction with the feedback myograph, the digital integrator computed average EMG activity in

microvolts, over the selected time intervals, and presented the data on a digital readout.

EMG feedback equipment. Audio feedback was provided through earphones, by the Autogen 1500 feedback myograph. However, although the feedback myograph was able to provide several types of audio feedback, only click feedback was presented in the EMG feedback training. This mode of audio feedback provided a continuous clicking signal, where the rate of clicking was logarithmically proportional to the level of EMG activity being monitored. Click feedback was selected because it is a relatively simple type of audio feedback, which should be readily understood by children, and it is particularly useful for monitoring gross EMG activity changes, which are likely to be associated with the initial stages of EMG feedback training. Another key feature of the feedback myograph was the choice of five logarithmic scales (X 0.1, X 0.5, X 1.0, X 10, X 100), which allowed for the incorporation of a shaping procedure in the EMG feedback training. By selecting the appropriate scale, it was possible to provide each subject with an optimum level of feedback, that is, one that did not produce frustration and yet allowed learning to occur. The scale factor was selected such that the meter needle deflected as closely to the center of the meter as possible, and

the scale factor could be reset at any time when the Autogen 5100 digital integrator was not performing a computation. The EMG feedback unit functioned as shown in Figure I.



Functional Diagram of the EMG Feedback System

FIGURE I

CHAPTER IV

FINDINGS AND CONCLUSIONS

Basically, Chapter IV constitutes a restatement of the hypotheses presented in Chapter II, together with a presentation of the related findings and conclusions. In order to test the hypothesized effects of the different types of relaxation training, a one way analysis of variance (Ferguson, 1971, p.216) and the t test (Ferguson, 1971, p.269) were applied to the data of both post-treatment sessions. However, prior to testing the specific hypotheses, a one way analysis of variance and the Hartley test (Winer, 1971, p.206) were used to analyse the pretreatment data.

Table 1 shows the means and the standard deviations of the pretreatment scores for the three groups. The overall pretreatment mean for all subjects was 8.23 μV, with a standard deviation of 0.52.

TABLE 1

SUMMARY OF PRETREATMENT EMG (μV) ACTIVITY

GROUP	MEAN	S D	N
I PROGRESSIVE RELAXATION	8.28	0.52	10
II EMG FEEDBACK	8.15	0.58	10
III CONTROL	8.27	0.55	10

With reference to Table 2, a one way analysis of variance indicated that there was no significant

difference between the pretreatment means of the three groups ($F = 0.18$). In addition, the Hartley test showed that homogeneity of variance existed between the three groups ($F_{max} = 1.27$, $p > .05$).

TABLE 2

PRETREATMENT ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	VARIANCE ESTIMATE	F
BETWEEN	0.11	2	0.06	
WITHIN	8.11	27	0.30	0.18

HYPOTHESIS 1

Group I (progressive relaxation) and group II (EMG feedback), in contrast with group III (control), will exhibit lower levels of muscular tension in the frontalis 1 day after treatment

Findings

Table 3 shows the means and the standard deviations of the first post-treatment scores for the three groups.

TABLE 3

SUMMARY OF FIRST POST-TREATMENT EMG (μV) ACTIVITY

GROUP		MEAN	S D	N
I	PROGRESSIVE RELAXATION	7.55	0.28	10
II	EMG FEEDBACK	6.82	0.45	10
III	CONTROL	8.12	0.43	10

Referring to Table 4, a one way analysis of variance showed that there was a significant difference between

the first post-treatment means of the three groups ($F = 11.13$).

TABLE 4

FIRST POST-TREATMENT ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	VARIANCE ESTIMATE	F
BETWEEN	8.58	2	4.29	
WITHIN	10.41	27	0.39	11.13

As Table 7 shows, comparisons between the first post-treatment means of the experimental and control groups, using the t test, revealed a significant difference between the means of the progressive relaxation and control groups ($t = 2.06$, $p < .05$), and a greater significant difference between the means of the EMG feedback and control groups ($t = 4.68$, $p < .001$).

<u>Conclusion</u>

Statistical analysis of the data confirmed that group I (progressive relaxation) and group II (EMG feedback) in contrast with group III (control), exhibited significantly lower levels of muscular tension in the frontalis 1 day after treatment.

HYPOTHESIS 2

Group II (EMG feedback), in comparison with group I (progressive relaxation), will show a lower level of muscular tension in the frontalis 1 day after treatment.

<u>Findings</u>

With reference to Table 7, the t test indicated

the existence of a significant difference between the first post-treatment means of the progressive relaxation and EMG feedback groups ($t = 2.62$, $p < .02$).

Conclusion

On the basis of these results, it is possible to conclude that group II (EMG feedback), in comparison with group I (progressive relaxation), showed a significantly lower level of muscular tension in the frontalis 1 day after treatment.

HYPOTHESIS 3

Group I (progressive relaxation) and group II (EMG feedback) in contrast with group III (control), will demonstrate lower levels of muscular tension in the frontalis 29 days after treatment.

Findings

Table 5 shows the means and the standard deviations of the last post-treatment scores for the three groups.

TABLE 5

SUMMARY OF LAST POST-TREATMENT EMG (µV) ACTIVITY

GROUP		MEAN	S D	N
I	PROGRESSIVE RELAXATION	7.87	0.28	10
II	EMG FEEDBACK	7.32	0.42	10
III	CONTROL	8.20	0.73	10

Referring to Table 6, a one way analysis of variance showed that there was a significant difference between the last post-treatment means of the three

groups ($F = 7.49$).

TABLE 6

LAST POST-TREATMENT ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	VARIANCE ESTIMATE	F
BETWEEN	3.91	2	1.95	
WITHIN	7.04	27	0.26	7.49

As Table 7 shows, comparisons between the last post-treatment means of the experimental and control groups, using the t test, revealed no significant difference between the means of the progressive relaxation and control groups at the .05 level ($t = 1.44$, $p < .20$). However, a significant difference was indicated between the last post-treatment means of the EMG feedback and control groups ($t = 3.84$, $p < .001$).

Conclusion

On the basis of this analysis, Hypothesis 3 must be rejected. However, the results indicate that group II (EMG feedback), in contrast with group III (control), demonstrated significantly lower levels of muscular tension in the frontalis 29 days after treatment.

HYPOTHESIS 4

Group II (EMG feedback), in comparison with group I (progressive relaxation), will evidence a lower level of muscular tension in the frontalis 29 days after

treatment.

Findings

Referring to Table 7, the t test showed a significant difference between the last post-treatment means of the progressive relaxation and EMG feedback groups ($t = 2.40$, $p < .05$).

Conclusion

The conclusion warranted on the basis of this analysis is that group II (EMG feedback), in comparison with group I (progressive relaxation), evidenced a significantly lower level of muscular tension in the frontalis 29 days after treatment.

TABLE 7

SUMMARY OF DIFFERENCES BETWEEN PAIRED GROUP MEANS

COMPARISON GROUPS	FIRST POST-TREATMENT t	p
I : II	2.62	$.01 < p < .02$
III : I	2.06	$.02 < p < .05$
III : II	4.68	$p < .001$
COMPARISON GROUPS	**LAST POST-TREATMENT t**	**p**
I : II	2.40	$.02 < p < .05$
III : I	1.44	$.10 < p < .20$
III : II	3.84	$p < .001$

CONCLUSIONS

In summary, hypothesis I, that the experimental groups, in contrast with the control group, would exhibit lower levels of muscular tension in the frontalis 1 day after treatment, was supported. Hypothesis 2, that the EMG feedback group, in comparison with the progressive relaxation group, would show a lower level of muscular tension in the frontalis 1 day after treatment, was also supported. However, hypothesis 3, that the experimental groups, in contrast with the control group, would demonstrate lower levels of muscular tension in the frontalis 29 days after treatment, was not confirmed. Nevertheless, while there was no significant differences in muscular tension between the progressive relaxation and control groups, the EMG feedback group did evidence a significantly lower level of muscular tension than the control group at this time. Hypothesis 4, that the EMG feedback group, in comparison with the progressive relaxation group, would evidence a lower level of muscular tension in the frontalis 29 days after treatment, was supported, however.

The results of this study suggest that, as a consequence of training, the EMG feedback group subsequently showed lower levels of muscular tension than the progressive relaxation group. Therefore,

support is lent to the basic hypothesis that EMG feedback is a more effective type of relaxation training for children than relaxation training based on Jacobson's progressive relaxation techniques.

CHAPTER V

DISCUSSION AND IMPLICATIONS

The primary objective of this research was to investigate the relative effectiveness of different types of relaxation training with children. More specifically, the current study sought to compare the effectiveness of EMG feedback with that of Jacobson's progressive relaxation training. In Chapter V, the results are discussed both in relation to the objectives of this study and in terms of some of the theoretical and practical issues in the area of EMG feedback training for children. Following the discussion, a number of implications for further research and counselling are outlined.

DISCUSSION

The results of this study indicate that it is possible to teach children muscle relaxation skills, which Brown (1974), Haugen et al. (1958), Jacobson (1967a) and Luce and Peper (1971) consider to be a preventive measure against psychosomatic and emotional disorders. Of course, this study cannot resolve the question regarding the protective value of early relaxation training, but it does suggest the viability of research designed to investigate the long term effects of training children in relaxation.

As predicted, the results of this study lend support to the hypothesis that EMG feedback is a more effective type of relaxation training for children than relaxation training based on Jacobson's progressive relaxation techniques. During both post-treatment sessions, the EMG feedback group demonstrated significantly lower levels of muscular tension in the frontalis than the progressive relaxation group. The superiority of the EMG feedback group is consistent with the idea that during EMG feedback training a pairing of proprioceptive and exteroceptive feedback occurs, which strengthens the discriminative value of the proprioceptive cues to a greater extent than Jacobson's techniques (Cleaves, 1970). Similarly, the superiority of the progressive relaxation group over the control group, during the first post-treatment session, is congruent with the assumption that the specific direction of effort and attention to the production and experience of proprioceptive feedback, involved in Jacobson's techniques, strengthens the discriminative value of the proprioceptive cues to a greater degree than simple undirected practice, as reflected by the control group.

The fact that EMG feedback from the frontalis appears to be effective with children may have considerable significance in the area of relaxation training for children. Firstly, if it is the case for

children, as it appears to be for adults, that the frontalis is a relatively difficult muscle to relax, then the results of this study indicate that EMG feedback training on other muscular sites should also be successful with children. Secondly, if, as Budzynski and Stoyva (1969; 1972) suggest, deep relaxation of the frontalis is followed by a generalization of relaxation to other muscle groups, then EMG feedback training on the frontalis alone may constitute a convenient general relaxation procedure for children. Apparently, however, research specifically designed to evaluate EMG feedback training on the frontalis as a general relaxation technique has yet to be undertaken.

Contrary to expectation, there was no significant difference at the .05 level in mean levels of muscular tension between the progressive relaxation and control groups, during the last post-treatment session. In addition, although the difference between the means of the EMG feedback and control groups was significant at the same level ($p < .001$) for both post-treatment sessions, the tendency was in the direction of a diminishing difference. These observations lead to the conclusion that some deterioration of the skills, acquired by the training groups, occurred during the period between the first and last post-treatment sessions. In this regard, it is possible that a larger number of training sessions may have resulted in enhanced skill

attainment, thereby promoting better skill retention. Some indication that a more extensive training period may have produced superior skill attainment is provided by Reinking and Kohl's (1974) study of undergraduates. These authors indicate that both the progressive relaxation and EMG feedback groups reached their lowest mean levels of muscular tension during session 15 of training. Furthermore, a number of investigators, including Budzynski, Stoyva, Adler and Mullaney (1973) and Jacobson (1970), advocate regular practice for the maintenance of muscle relaxation skills. None of the subjects in the present study were asked to practice their relaxation skills, and, in the absence of any incentive to do so, it is conjecturally possible that practice did not occur.

As previously mentioned, many theorists subscribe to the idea that excess muscular tension begins to develop early in life (Budzynski, 1973; Haugen et al., 1958; Hefferline & Bruno, 1971; Lang, 1970; Wolpe, 1958), and the results of the present study seem to lend some support to this contention. As noted in Chapter IV, the pretreatment mean level of EMG activity for all subjects was 8.23 μV. Since the pretreatment session did not require activity in the frontalis, and bearing in mind that there is usually an absence of neuromuscular activity in a muscle that is fully relaxed (Basmajian, 1967), this mean level of 8.23 μV appears to

represent the initial mean level of excess muscular tension for all subjects in this study.

Finally, it should be noted that the subjects who participated in this study, including the controls, expressed marked interest in the experimental proceedings. Although this experiment was conducted as an extracurricular course in relaxation training, many subjects evidenced disappointment when their sessions were completed. During the study, most of the subjects asked how they were doing. Such requests for evaluation were met with the standard reply, "You're doing fine." In the pilot work, 30 minutes was indicated as a suitable time period for each session, and this length of session appeared to work well in the study, with none of the subjects complaining of boredom, discomfort or fatigue. In addition, the subjects exhibited no reservations regarding the EMG equipment, which is sometimes reported to have been a problem in studies of this type (Cleaves, 1970). The apparent lack of anxiety regarding the experimental situation, was probably due to the fact that this study was conducted in the familiar school setting by the school counsellor.

IMPLICATIONS

Research Implications

A number of implications for further research with

children are suggested by the preceding discussion. These may be elucidated as follows:

1. It would be useful to investigate the effects of deep muscular relaxation in the frontalis on other muscle groups, in order to evaluate the effectiveness of EMG feedback training on the frontalis as a general relaxation training technique.
2. If EMG feedback training on the frontalis is not effective as a general relaxation training technique, then research designed to determine which muscle groups are relatively difficult to relax would be of interest. Such information would be useful in testing the potency of EMG feedback training on the most difficult muscular sites.
3. Further research conducted to determine the number and frequency of training sessions for optimal skill attainment, and the effects of different training schedules on both short and long term skill retention, would also be of practical interest to clinicians and investigators in the area of relaxation training.
4. Similarly, the contribution of practice to the maintenance of muscle relaxation skills should be investigated.
5. Finally, research designed to evaluate the long term effects of early training in relaxation appears to be both a necessary and significant undertaking.

Practical Implications

For the counsellor, the results of this study suggest that EMG feedback training with children has a number of potential applications, which may be outlined as follows:

1. EMG feedback training may be of use in inhibiting anxiety during systematic desensitization therapy.
2. Where relaxation training, alone, is used to treat anxiety, EMG feedback training would appear to have potential.
3. Finally, in the case of a tense client, EMG feedback training may be useful in facilitating other treatment techniques.

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APPENDICES

A. Transcript of Progressive Relaxation Training Tape Recording

"The instructions that you hear through your earphones will help you to relax your forehead. Do not go to sleep or close your eyes, but keep your attention on what you are told to do. Ready? Frown as hard as you can. Hold it. Hold it. Notice the feeling of tension in your forehead." (Pause). "Let it go, and notice the feeling of relaxation. Let it go further and further, past the point where your forehead feels to be perfectly relaxed." (2 minute silence). "Now, frown again as hard as you can. Hold it. Hold it. Notice the feeling of tension in your forehead." (Pause). "Let it go, and notice the feeling of relaxation. Let it go further and further, past the point where your forehead feels to be perfectly relaxed." (2 minute silence). "Now, frown just enough to notice the feeling of tension in your forehead. Hold it. Hold it. Notice the feeling of tension in your forehead." (Pause). "Let it go, and notice the feeling of relaxation. Let it go further and further, past the point where your forehead feels to be perfectly relaxed." (2 minute silence). "Now, frown just enough to notice the feeling of tension in your forehead. Hold it. Hold it. Notice

the feeling of tension in your forehead." (Pause). "Let it go, and notice the feeling of relaxation. Let it go further and further, past the point where your forehead feels to be perfectly relaxed." (2 minute silence). Now, do not frown, but start from where you are. Notice any slight feeling of tension in your forehead." (Pause). "Let it go, and notice the feeling of relaxation. Let it go further and further, past the point where your forehead feels to be perfectly relaxed." (2 minute silence).

B. Transcript of EMG Training Tape Recording

"The instructions that you hear through your earphones will help you to relax your forehead. Do not go to sleep or close your eyes, but keep your attention on what you are told to do. Now, during this period, you will hear a series of clicks in your earphones. The click rate is proportional to the tension in your forehead. If you are relaxing your forehead, then the clicks will slow down, like this." (Slow click rate). "But, if you are tensing your forehead, then the clicks will speed up, like this." (Fast click rate). "Your task during this period will be to find out how to make the click rate slow down, because this means that you are relaxing your forehead. Remember make the clicks go as slow as you can."

C. Transcript of No Relaxation Training Tape Recording

"The instructions that you hear through your earphones will help you to relax your forehead. Do not go to sleep or close your eyes, but keep your attention on what you are told to do. Your task during the rest of this period is to relax as completely as you can, especially your forehead. I repeat, your task during this period is to relax as completely as you can, especially your forehead."